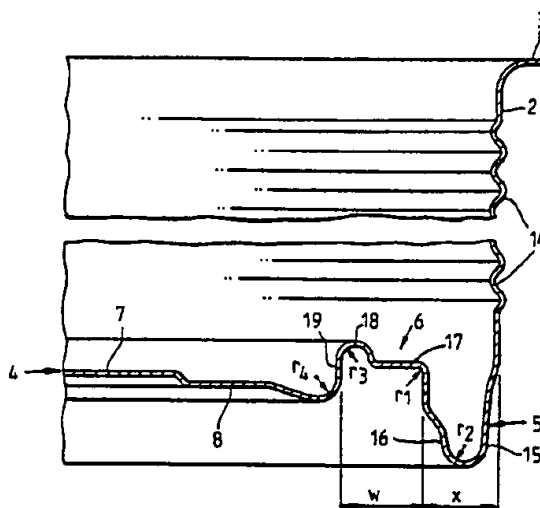




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(21) International Application Number: PCT/GB93/01457 (22) International Filing Date: 13 July 1993 (13.07.93) (30) Priority data: 9216247.8 30 July 1992 (30.07.92) GB (71) Applicant (for all designated States except US): CAR- NAUDMETALBOX PLC [GB/GB]; Woodside, Perry Wood Walk, Worcester WR5 1EQ (GB). (72) Inventors; and (75) Inventors/Applicants (for US only) : CLAYDON, Paul, Charles [GB/GB]; 38 Blackcroft, Wantage, Oxon OX12 9YA (GB). McMAHON, Neil [GB/GB]; 10 Compass Close, Cowley, Oxford, Oxon OX4 3SX (GB). (74) Agent: OWEN, Robert, Anthony; Carnaudmetalbox Tech- nology plc, Downsvie Road, Wantage, Oxon OX12 9BP (GB).		(81) Designated States: AU, BR, JP, NO, NZ, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>With amended claims.</i>

(54) Title: DEFORMABLE END WALL FOR A PRESSURE-RESISTANT CONTAINER

**(57) Abstract**

An end wall for a can body has a central panel (7) surrounded by a conventional expansion ring (8) which is connected to an inner wall (16) of a channel portion by an upwardly extending deformable annulus (17, 18) so that during thermal processing of a closed can having this end wall, the deformable annulus changes shape to permanently increase the container volume. The deformable annulus protects the side wall and ends of the can from excessive pressure so thinner container materials may be used.

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DEFORMABLE END WALL FOR A PRESSURE-RESISTANT CONTAINER

This invention relates to metal containers and more particularly but not exclusively to the bottom wall of a container drawn from a circular blank to comprise a bottom wall and a side wall upstanding from the periphery of the bottom wall.

A widely used container for petfoods, typically 73mm diameter by 56mm tall comprises a substantially flat centre panel surrounded by a flexible annulus which is joined to a channel portion, or stand bead, having an inner wall joining the flexible annulus and an outer wall joining the side wall of the container. The containers are usually drawn from a laquered steel such as electrochrome coated steel or tinfoil in temper DR8 of thickness 0.17 mm (about 0.007"). The side wall of this can is vulnerable to damage at point of sale. When the containers are filled, the closing machine applies a top pressure to a can end while a double seam is rollformed to join the can end to the side wall, so the side wall has to be strong enough to support this top load. When the closed containers are thermally processed the contents of the can expand so pressure develops in the container and the side wall is protected from undue distortion because the flexible annulus permits the bottom wall to bulge outwardly to increase the container volume. As the container cools, the pressure in the can abates. If the product is hot filled, a partial vacuum may develop in the container when cooled to room temperature so putting the side wall at risk of collapse unless the flexible annulus returns towards original shape.

Can ends which provide the desired expansion and contraction in container volume by simple flexure are described in US Patents 3105765 (Creagan) and 3409167 (Blanchard), and in British Patent Publications 2107273 and 2119743 (of American Can Company) but in all these

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patents the change of volume available in a filled and closed can is limited to that available from flexure, not permanent change of shape.

These volume change requirements are made more
5 stringent if tall cans having a wall ironed side wall are used because the side wall may be between 0.075mm (0.004") and 0.0125mm (0.005").

A first objective of this invention is to provide a container having an end wall which will provide an
10 increased volume during thermal treatment to reduce the pressures generated within the can during thermal processing. A second objective is to provide some flexibility to compensate for a residual partial vacuum in a filled and closed can. The end wall may be integral
15 with the side wall of a drawn can body or alternatively the end wall may be a can end or lid.

Accordingly, this invention provides a container end wall comprising a peripheral channel portion or cover hook, an inner wall of which supports a centre panel,
20 characterised in that,

a deformable bistable annulus extends both radially and axially inwards away from the inner wall to support a dependent annulus which connects the centre panel to the deformable annulus so that when subjected to pressure
25 inside the container, the deformable annulus is permanently deflected from its initial stable position to its second stable position and the centre panel is temporarily deflected axially outwards. The increase in container volume arising, reduces the pressure generated
30 on the side wall and end walls of the container so that, if desired, thinner metal may be used. The centre panel may have at least one flexible expansion ring surrounding a central panel portion.

In one embodiment, the deformable annulus comprises a substantially flat annular portion which extends radially inwards from the inner wall of the channel portion or

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cover hook and surrounds an annular bead of arcuate cross-section which extends away from the inner wall before turning to join a dependent substantially cylindrical wall portion which connects the centre panel 5 and ring to the deformable annulus.

An outer wall of the channel portion may have a peripheral cover hook for attachment to the flange of the side wall of a container body; or alternatively the outer wall of the channel portion may connect with the side wall 10 of a can body drawn from a blank.

In another embodiment the deformable annulus is frustoconical and may, if desired, be provided with a plurality of stiffening beads which extend across its width to bias the deformable panel to either its original 15 shape or its deformed shape.

In preferred embodiments the radial width of the deformable annulus is greater than the width of the channel portion. The channel portion preferably comprises an inner wall joined to an outer wall by a bead of arcuate 20 cross-section typically of the order of 1.0mm (about 0.004").

The inner wall and deformable panel are connected by a radius of the order of 0.7mm (0.003"), at which bending takes place as the deformable annulus moves.

25 Various embodiments will now be described by way of example and with reference to the accompanying drawings in which:

Fig.1 is a part sectioned side view of a can body drawn from a sheet metal blank;

30 Fig.2 is a like view of the can body of Fig.1 after filling, closing, heating and cooling;

Fig.3 is an underplan view of the can body of Fig.1;

Fig.4 is an enlarged fragmentary section of a preferred embodiment of the can body;

Figs.5, 6 and 7 are diagrammatic sectional views of the can bottom when empty, after filling and closing but

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during early heating of a thermal process, and after final cooling of the processed can to ambient temperature.

Fig.8 is a graph of bottom wall deflection plotted against internal pressure in the closed can;

5 Fig.9 is a diagrammatic sketch of a press tool with formed can body.

Fig.10 is a fragmentary section of a first alternative embodiment of an end wall profile;

Fig.11 is a fragmentary section of the end wall of 10 Fig.10 with additional beads; and

Fig.12 is a side view of a can end sectioned on a diameter.

Figs.1 and 3 show a can body, 73mm diameter x 56mm tall, drawn from a circular blank of lacquered 15 electrochrome coated steel or tinfoil 0.12mm thick, comprising a cylindrical side wall 2 terminating at one end in an outwardly directed flange 3 and closed at the other end by an integral bottom wall 4. The bottom wall comprises a peripheral channel portion 5, a deformable 20 annulus 6 and a central panel 7 surrounded by flexible expansion panels 8. The central panel 7 can be seen to be held at a level just above an optional stacking ledge 9 in Fig.1.

Fig.2 shows the can body of Fig.1 after filling with 25 a product 10 and closing by a can end 11 attached to the flange of the body by a double seam 12. Under the influence of pressure arising during heating of this closed can to thermally process the product, the deformable annulus 6 has been deflected from the generally upward attitude shown in Fig.1, by bending at radius r_1 to 30 the generally downward attitude 6A shown in Fig.2. Consequently the internal volume of the closed can body has been permanently increased by about 10ml. However, the central panel 7 and its expansion rings continue to move under the influence of internal pressure in the can so that as the product cools and a partial vacuum

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develops, the centre panel is pulled towards its original shape.

As shown in Fig.2 the fully processed can is able to stand on a flat surface 13 with the central panel 7 just 5 below the level of the stacking bead 9 but clear of the support surface 13.

Fig.4 shows a details of a preferred embodiment of the can body described with reference to Fig.1. In Fig.4, the side wall has been provided with a plurality of hoop 10 beads 14 which stiffen the thin side wall metal against expansion or collapse so that the top end and bottom wall of the can have to provide movement to accommodate pressure change as the can and contents are thermally processed.

15 The channel portion 5 could usefully have an outer wall 15 coaxial with the side wall and a simple cylindrical inner wall 16 joined by an annular bead of arcuate cross-section radius r_2 . However, as shown in Fig.4, the outer wall 15 is of reduced diameter to permit 20 stacking of the can body inside the double seam 12 of a lidded can, as shown in Fig.2. The inner wall 16 is also stepped to give clearance for the pull tab of tear open can end (not shown) which may be required on some cans.

In Fig.4, it will be seen that the deformable annulus 25 6 comprises a flat annular ledge 17 which surrounds an outwardly concave annular bead 18 of radius r_3 upstanding from the inner periphery of the ledge before it turns downwards to a dependent cylindrical wall portion 19 that joins the periphery of the periphery of the flexible panel 30 8 at a radius r_4 . The flexible panel 8 and centre panel 7 behave conventionally as will be understood in the art.

Typical dimensions for the bottom wall shown in Fig.4 are:

r_1 deformable annulus/inner wall	0.1mm
r_2 stand bead radius	0.8mm
r_3 radius of bead 18	0.75mm

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r_4 dependent wall to flexible panel	0.7mm
w radial width of deformable annulus	5.0mm
x maximum width of channel	3.5mm

It will be noticed that the deformable annulus is 5 wider than the channel portion so that it receives a greater pressure thrust force than the channel which is designed to remain stiff and unmoved.

Fig.5 is presented to show the bottom profile of the empty can body on a larger scale to permit comparison with 10 Figs.6 and 7, and understanding of the graph Fig.8.

Fig.6 shows the bottom wall 4 of the can body at an early stage in the heating of the filled and closed can. Expansion of the product 10 has increased pressure p in the can to distend the central panel 7 and flexible panel 15 8 so that the inner periphery of the deformable annulus 6 is subjected to a downward force.

Fig.7 shows the bottom wall 4 after the processed can and contents have been cooled to ambient temperature and a partial vacuum V has developed to pull the centre panel 7 20 and flexible ring 8 towards their original unpressurised shape. In Fig.7, it can be seen that the deformable annulus 6 has hinged downwards at radius r_1 , the flat ledge 17 has become approximately frustoconical to extend radially inwards and axially into the inner wall 16 and 25 the radius r_3 has been opened out to almost a ledge 18A so that the cylindrical wall portion 19 has moved to lower the central panel portions 7, 8 and create a permanent additional volume of about 10ml.

In Fig.8 the pressure inside the can during thermal 30 processing is plotted against movement of the centre of the central panel 7 (full lines) and movement of the bead portion 18 of the deformable annulus (dashed lines). As pressure rises from atmospheric (denoted 0) the centre panel starts to move quickly but the bead motion rises more slowly (see V on graphs indicating the shape shown in Fig.5).

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At about 10psi overpressure in the can there is a sudden rise in both movement graphs (see VI denoting the can shape shown in Fig.6) because the deformable panel starts to change shape rapidly and accommodate the increasing pressure in the can. In this trial, the maximum internal pressure was raised to 20psi by which pressure the centre panel was moved 0.275" (6.9mm) and the bead 18 was moved 0.150" (3.7mm). On cooling, the centre of the can bottom returns to the shape of Fig.7 denoted VII on the graph, with a resultant increase of 5% in contained volume (10ml in 210ml).

The benefit arising from this increase in container volume is that the thin side wall and end components are protected from pressure which may reform or burst them. Therefore it is possible to use thinner container materials. The thinner wall material may, if desired, be reinforced by hoop panelling as described or made expandable by vertical panels designed to flex inwards and outwards, if desired.

Fig.9 shows a press tool 20 in which the bottom wall 4 of the can body 1 is formed between an upper tool 21 and a lower tool 22. The upper tool comprises a sleeve 23 which surrounds a centre pad 24. The lower tool comprises an annular die 25 which surrounds a punch 26. The radius between the inner wall 16 and deformable annulus 6 are formed by closing of the tools 21, 22 together. In order to achieve the desired value of radius r_1 and r_2 an annular punch bead 27 pushes metal into centre pad groove 28 to pull the metal tight so that, on parting of the tools 21, 22 the radii 21, 22 are correctly defined.

Fig.10 shows an alternative shape for the deformable annulus in which the flat ledge 17 and bead 18 are replaced by an upwardly and inwardly extending frustoconical portion 30. In other respects the bottom wall is similar to the bottom wall shown in Fig.4 so the same integer numbers are used to denote the dependent wall

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19 and inner wall 16 of the channel.

Fig.11 shows a modified form of the wall of Fig.10 in which the frustoconical deformable annulus 30 is provided with a plurality of equispaced hollow beads 31 to stiffen 5 the annulus and encourage it to suddenly evert from the upwardly inclined shape to a downwardly inclined shape as pressure in the can rises.

Fig.12 shows a can end suitable for fixing to a can body by means of a double seam. This can end uses the 10 principles hereinbefore discussed to provide a permanent increase in container volume during thermal processing.

In Fig.12 the can end comprises a flat central panel 37, an annular expansion ring 38 surrounding the central panel, an annular wall 39 depending from the periphery of 15 the expansion ring 38, an outwardly concave bead 318 which turns outwardly from the annular wall, an annular ledge 317 extending outwardly from the bead 318, an inner wall 316 of a channel portion 315, which extends to a peripheral cover hook 400.

20 The annular ledge 317 and bead 318 behave in the manner described above under the influence of pressures arising during thermal processing of a filled can so that this can end may be used to protect the thin side wall or ends of a can having a side seam or made by deep drawing 25 of a blank. This can end may, if desired, provide volume change additional to that available from a similarly profiled can bottom.

C L A I M S

1. A container end wall comprising a peripheral channel portion or cover hook, an inner wall of which supports a centre panel, characterised in that,
A deformable bistable annulus extends both radially
5 and axially inwards away from the inner wall to support a dependent annulus which connects the centre panel to the deformable annulus so that when subjected to pressure inside the container, the deformable annulus is permanently deflected from its initial stable position to
10 its second stable position and the centre panel is temporarily deflected axially outwards.
2. A container end wall according to claim 1 wherein a central panel comprises a central panel portion surrounded by at least one flexible expansion panel which
15 is connected to the deformable annulus by a stiff substantially cylindrical wall portion.
3. A container end wall according to claim 1 or claim 2 wherein the deformable annulus comprises, in its initial stable position, a substantially flat annular
20 portion which extends radially inwards from the inner wall and surrounds an annular bead of arcuate cross-section which extends axially away from the flat annular portion before turning to join the dependent annulus.
4. A container end wall according to any preceding claim
25 wherein an outer wall of the channel portion is a peripheral cover hook for attachment to the flange of the side wall of a container body.
5. A container end wall according to one of claims 1 to 3 wherein the outer wall of the channel portion connects with the side wall of a can body drawn from a blank.
- 30 6. A container end wall according to any preceding claim wherein the deformable annulus is frustoconical.

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7. A container end wall according to claim 5 wherein the frustoconical deformable annulus has a plurality of stiffening beads which extend across its width.
8. A container end wall according to claim 5 wherein the radial width of the deformable annulus is greater than the width of the channel portion.
9. A container end wall according to any preceding claim wherein the inner wall and deformable panel are connected by a radius of the order of 1.0mm.
- 10 10. A container end wall according to claim 3 wherein the radius of curvature of the annular bead is of the order of 0.75mm.
11. A container end wall substantially as hereinbefore described with reference to Figs.1, 2 and 3, Figs.6, 7, 8 15 and 9, Fig.10, Fig.11 or Fig.12 of the accompanying drawings.

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AMENDED CLAIMS

[received by the International Bureau on 8 November 1993 (08.11.93); original claim 1-10 amended; remaining claim 11 unchanged (2 pages)]

1. A container end wall (4), comprising a peripheral channel portion (5), or cover hook (315), an inner wall (16, 316) of which supports a centre panel (7, 37), characterised in that,
A deformable bistable annulus (6, -) extends both radially and axially inwards away from the inner wall (16, 316) to support a dependent annulus (19, 39) which connects the centre panel (7, 317) to the deformable
5 annulus (6, -) so that when subjected to pressure inside the container, the deformable annulus is permanently deflected from its initial stable position to its second stable position and the centre panel (7, 317) is temporarily deflected axially outwards.
- 10 2. A container end wall according to claim 1 wherein a central panel (7, 37) comprises a central panel portion surrounded by at least one flexible expansion panel (8, 38) which is connected to the deformable annulus by a stiff substantially cylindrical wall portion (19, 39).
- 15 3. A container end wall according to claim 1 or claim 2 wherein the deformable annulus comprises, in its initial stable position, a substantially flat annular portion (17, 317) which extends radially inwards from the inner wall and surrounds an annular bead (18, 318) of
20 arcuate cross-section which extends axially away from the flat annular portion before turning to join the dependent annulus (19, 39).
4. A container end wall according to any preceding claim wherein an outer wall (315) of the channel portion is a
25 peripheral cover hook (316) for attachment to the flange of the side wall of a container body.
5. A container end wall according to one of claims 1 to 3 wherein the outer wall (15) of the channel portion (5) connects with the side wall 2 of a can body drawn from a
30 blank.

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6. A container end wall according to any preceding claim wherein the deformable annulus (30) is frustoconical.
7. A container end wall according to claim 5 wherein the frustoconical deformable annulus (30) has a plurality of stiffening beads (31) which extend across its width.
8. A container end wall according to claim 5 wherein the radial width of the deformable annulus (6, 30) is greater than the width of the channel portion.
- 10 9. A container end wall according to any preceding claim wherein the inner wall (16) and deformable annulus (30) are connected by a radius r , of the order of 0.1mm.
10. A container end wall according to claim 3 wherein the radius of curvature of the annular bead (18, 318) is 15 of the order of 0.75mm.
11. A container end wall substantially as hereinbefore described with reference to Figs.1, 2 and 3, Figs.6, 7, 8 and 9, Fig.10, Fig.11 or Fig.12 of the accompanying drawings.

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Fig.1

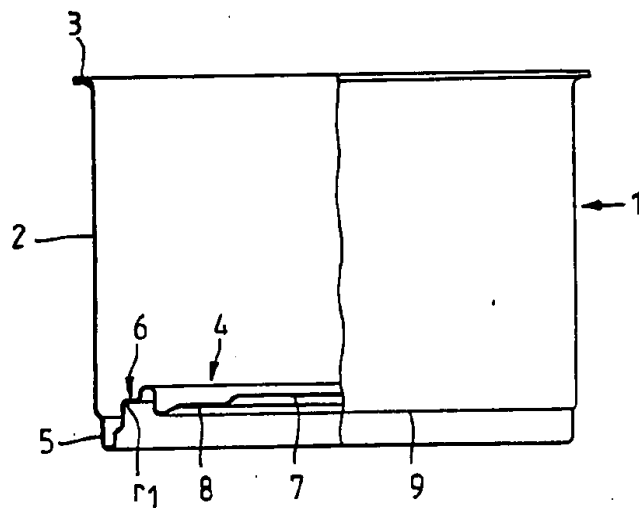


Fig.2

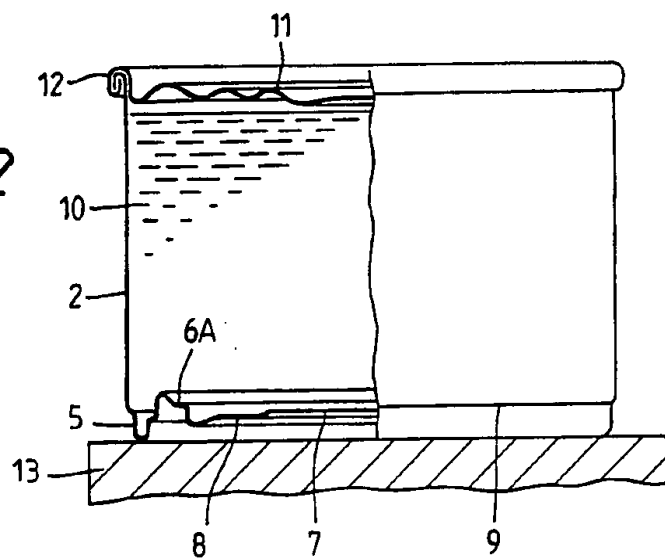
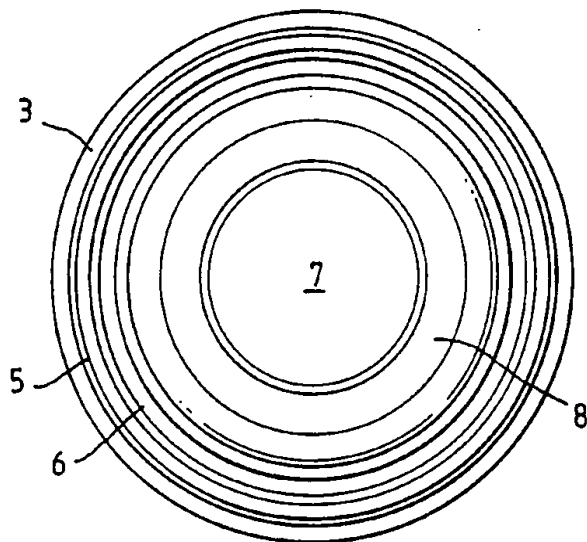


Fig.3



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Fig. 4

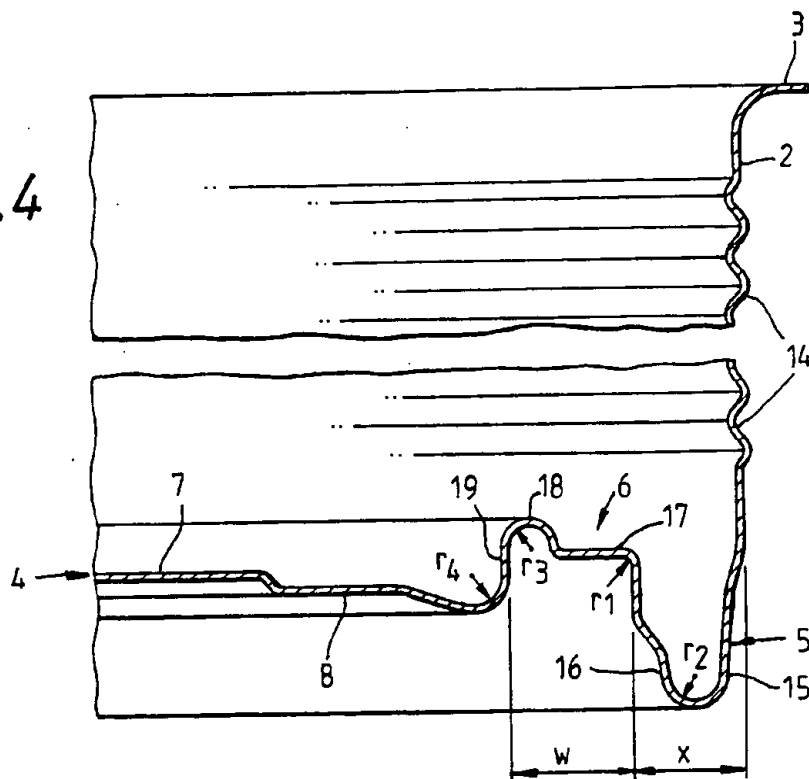


Fig. 5

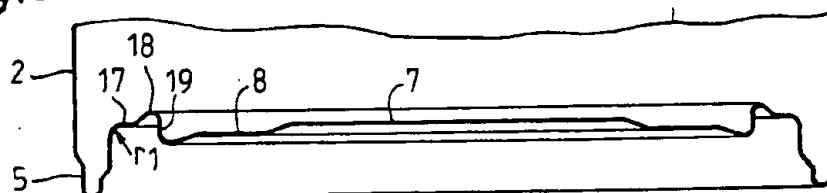


Fig. 6

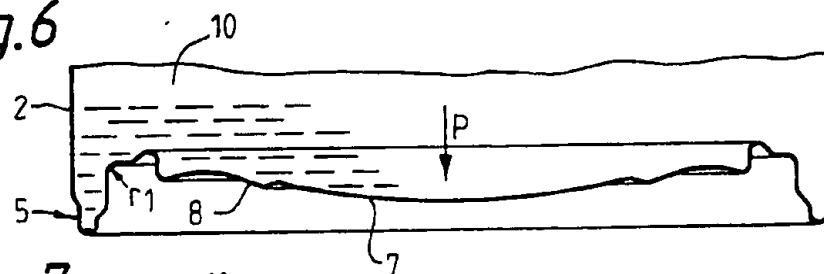
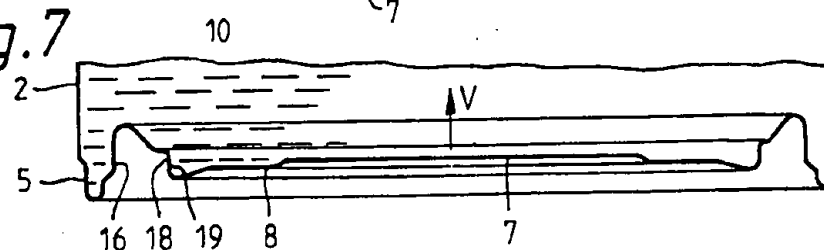
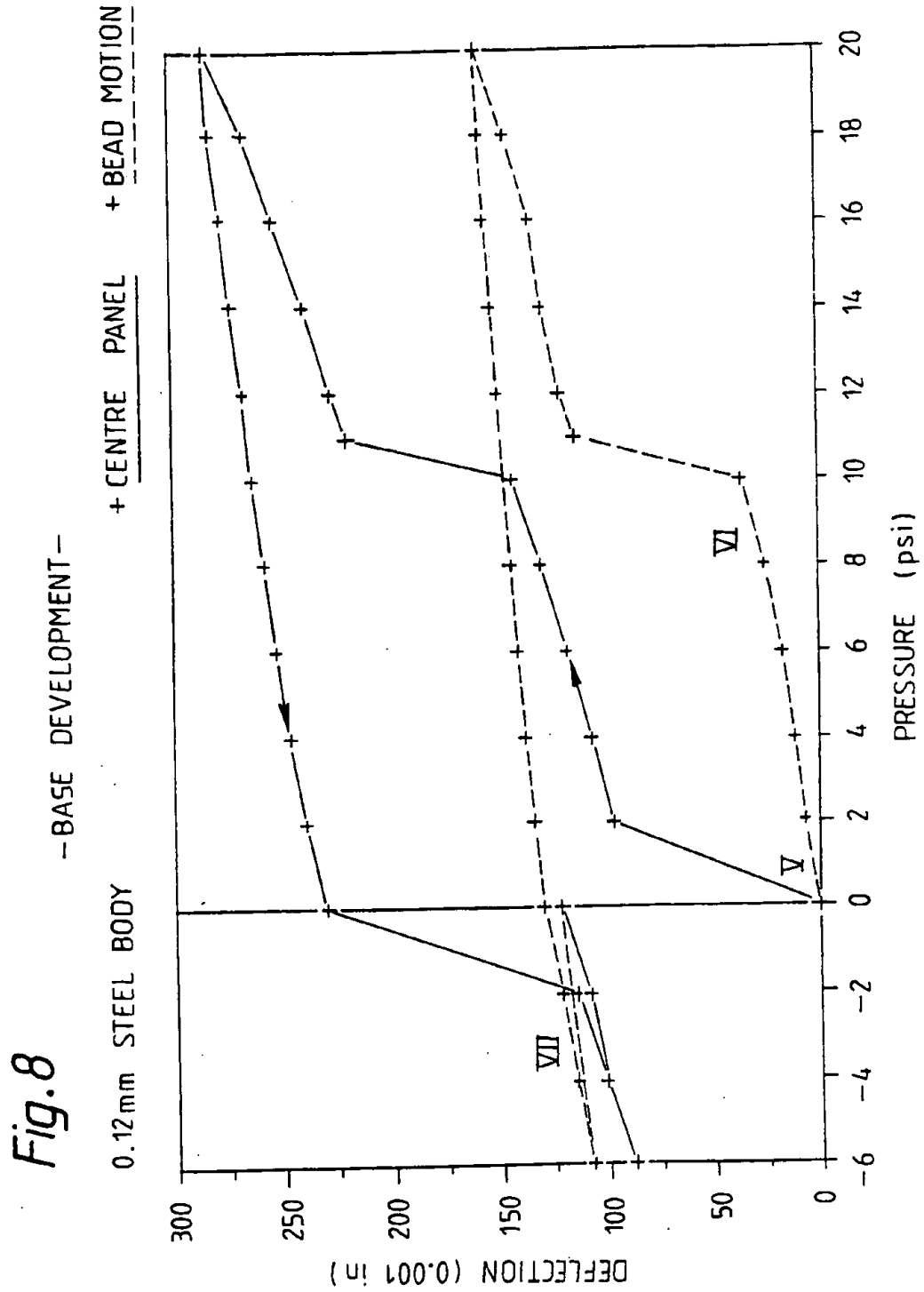


Fig. 7



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Fig.9

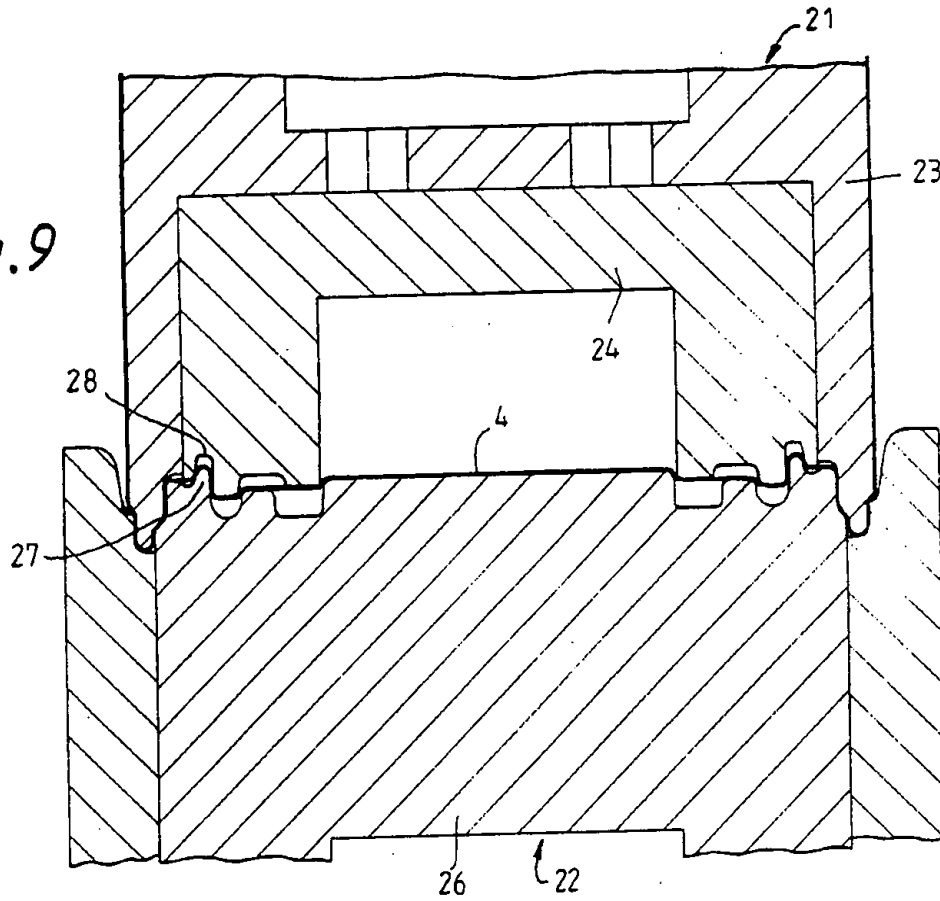


Fig.10

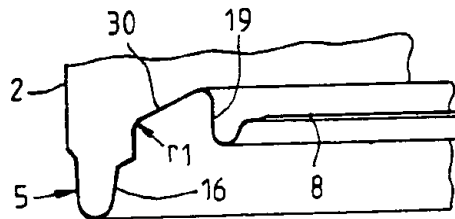


Fig.11

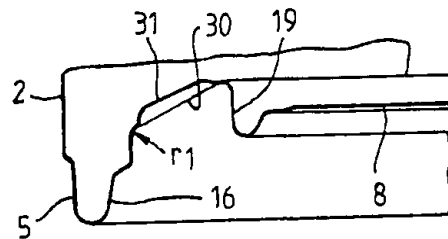
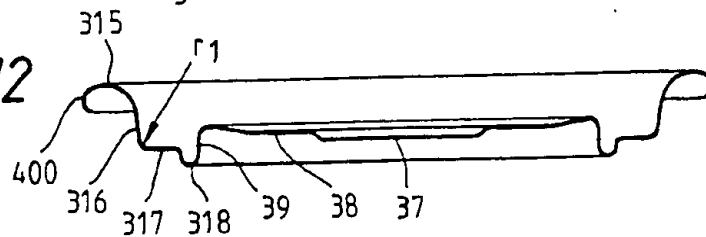


Fig.12



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INTERNATIONAL SEARCH REPORT

PCT/GB 93/01457

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 B65D1/40		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B65D	
Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US,A,3 105 765 (CREEGAN) 1 October 1963 see figures 4-7 ---	1-2,4,6
Y	DE,A,1 586 488 (BELLAPLAST HELLER) 27 January 1972 see page 2, last paragraph - page 4, paragraph 1; figure ---	1-2,4,6
A	US,A,3 409 167 (BLANCHARD) 5 November 1968 see column 3, line 7 - line 16; figures 3-4 ---	3,5,8
A	US,A,4 616 761 (NOLAN) 14 October 1986 see column 5, line 5 - line 31; figure 5 -----	7
<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 28 SEPTEMBER 1993		Date of Mailing of this International Search Report - 7. 10. 93
International Searching Authority EUROPEAN PATENT OFFICE		Signature of Authorized Officer Alain BRIDAULT

Form PCT/ISA/210 (second sheet) (January 1985)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB93/01457

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 11
~~because they are dependent claims and are not entitled in accordance with the second and third sentences of Rule 6.4(a)~~
See Rule 6.2 (a) PCT

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9301457
SA 76538

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3105765		None	
DE-A-1586488	27-01-72	FR-A- 1547599	
US-A-3409167		None	
US-A-4616761	14-10-86	CA-A- 1249240	24-01-89
		EP-A- 0233391	26-08-87
		ZA-A- 8601241	21-08-86

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82